California Regional Water Quality Control Board

Central Valley Region

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TO: Technical Staff and Other Interested Persons

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DATE: 20 November 2001

SIGNATURE: 

SUBJECT: WATER QUALITY GOALS UPDATE

This is the sixth notice of changes since the publication of the August 2000 edition of *A Compilation of Water Quality Goals*. This notice contains an explanation of the most recent changes as well as instructions for updating your copy of *Water Quality Goals*. In addition, new information is provided to help users select among available numerical limits to interpret narrative water quality objectives. The *Water Quality Goals* report and all updates may be obtained on the internet at www.swrcb.ca.gov/rwqcb5/available_documents/wq_goals.

New Public Health Goals

In August and September, the California Office of Environmental Health Hazard Assessment (OEHHA) released four new Public Health Goals (PHGs) for chemicals in drinking water:

Nickel	12	ug/L (ppb)	
Simazine	4	ug/L	
Tetrachloroethylene (PCE)	0.06	ug/L	
Uranium (from natural sources)	0.5	ug/L	(0.43 pCi/L)

PHGs are levels of drinking water contaminants at which adverse health effects are not expected to occur from lifetime of exposure. The California Safe Drinking Water Act of 1996 (Health and Safety Code Section 116365) requires OEHHA to adopt PHGs based exclusively on public health considerations. PHGs adopted by OEHHA will be considered by the California Department of Health Services (DHS) in establishing or revising primary drinking water standards (California Maximum Contaminant Levels, or MCLs). DHS is required by the same law to review their MCLs every five years and to revise them to as close to PHGs as is practicable, considering economic factors and technical feasibility. Technical support documents for PHGs are available on the internet at www.oehha.org/water/phg.

The PHGs for tetrachloroethylene and uranium are based on cancer risk. PHGs for carcinogens are set at the concentration in water associated with a *de minimis* or negligible level of cancer risk – one extra cancer case per million persons exposed over their lifetimes. For volatile contaminants, such as PCE, the use of drinking water in the home can cause exposure through not only the ingestion of water, but also through dermal contact and the inhalation of vapors resulting from showering and other household water uses. Therefore, PHGs for PCE and other volatile chemicals are calculated by considering all of these exposures. For this reason these PHGs are often lower than other one-in-a-million cancer risk estimates that consider only ingestion exposure. These additional exposure routes are relevant to the beneficial use of water for municipal and domestic supply (MUN).

PHGs and other toxicological criteria may be used to evaluate compliance with narrative water quality objectives for Toxicity in the Basin Plans, as these objectives relate to beneficial uses involving human exposures (e.g., municipal and domestic supply). Therefore, ambient groundwater or surface water with chemical concentrations above PHGs could be interpreted as violating water quality objectives if the waters are designated MUN.

Public Health Goals for Total and Hexavalent Chromium – An Update

In 1999, OEHHA published a Public Health Goal of 2.5 ug/L (ppb) for total chromium in drinking water. This PHG was based on the assumption that exposure to hexavalent chromium (Cr VI) in drinking water may cause cancer. The PHG technical support document included a health protective level of 0.2 ug/L for Cr VI, equal to the one-in-a-million cancer risk estimate in drinking water. The PHG for total chromium is based on the health protective level for Cr VI, assuming that total chromium contains no more than 7.2 percent Cr VI. Both the PHG for total chromium and the health protective level for Cr VI are reported in the August 2000 Edition of *A Compilation of Water Quality Goals*.

On 9 November 2001, OEHHA formally withdrew the PHG document for chromium. The PHG for total chromium and the cancer risk-based health protective level for Cr VI have been controversial. Recent data on drinking water sources collected by DHS and others have called into question the proportion of Cr VI in total chromium in California drinking water sources assumed by OEHHA. Many toxicologists, including those from the drinking water program of USEPA, disagree with OEHHA's assumption that Cr VI may cause cancer from drinking water exposure. As a result, OEHHA requested that the University of California (UC) convene a scientific panel of experts to provide guidance on health issues relating to the presence of Cr VI in drinking water. The Chromate Toxicity Review Committee, as the panel was called, has completed its review and has forwarded its report to OEHHA. The committee concluded that "we found no basis in either the epidemiological or animal data published in the literature for concluding that orally ingested Cr (VI) is a carcinogen."

OEHHA had asked the committee to examine the reliability of a key German study used by OEHHA to identify the health protective level for Cr VI and the PHG for total chromium. The study, published in 1968, is the only one of its kind that has examined long-term cancer risks from ingestion of Cr VI. Previous UC peer reviews of the PHG document had deemed the German study data as appropriate for deriving the PHG for total chromium. However, OEHHA was aware of the study's limitations and for that reason had asked the committee to examine it. The committee's report states that the study should not be used to assess cancer risks from Cr VI for several reasons. OEHHA no longer plans to use the study in future risk assessments on Cr VI because the committee presented information that a virus contracted by mice used in the study could have caused lesions observed by the German researchers and interpreted as chromium-induced tumors.

The committee proposes that California should continue to consider its current drinking water standard (maximum contaminant level) of 50 ug/L for total chromium to be protective of public health.[1] OEHHA is in the process of developing a separate PHG for Cr VI, which is expected to be complete by the Spring of 2003. That PHG will be used by DHS to develop a California drinking water standard for Cr VI. Legislation recently signed into law requires DHS to adopt a Primary MCL for Cr VI by 1 January 2004.

Arsenic – New Federal MCL and Information on Health Effects

On 31October 2001, USEPA adopted a new final drinking water MCL for arsenic of 10 ug/L The former MCL for arsenic of 50 ug/L (ppb) was developed by the US Public Health Service in 1942. It did not reflect current information on the health effects of arsenic, including bladder, lung and skin cancer, inhibition of tissue respiration, skin and mucus membrane irritation and necrosis, central and peripheral neurotoxicity, peripheral vascular disease, and reproductive and developmental toxicity. In January 2001, USEPA adopted the new federal MCL for arsenic of 10 ug/L. But in May, USEPA delayed the effective date of the new standard in order to conduct reviews of the scientific and economic analyses on which the new MCL was based.

In September 2001, a subcommittee of the National Research Council (NRC) released their review of the toxicologic basis for the new drinking water standard. The NRC report confirmed the finding that recent studies of arsenic in humans, taken together with earlier studies, "provide a sound and sufficient database showing an association between bladder and lung cancers and chronic arsenic exposure in drinking water, and they provide a basis for quantitative risk assessment." "In addition, recent studies increase the weight of evidence for an association between internal cancers and arsenic exposure through drinking water." "Taiwanese and other human studies include data on exposures at arsenic concentrations relatively close to some U.S. exposures. Consequently, the extrapolation is over only a relatively small range of arsenic concentrations." Shorter extrapolations decrease the uncertainty of numerical cancer risk estimates. The report also cited increasing evidence that chronic exposure to arsenic in drinking water may also be associated with health effects other than cancer.

"In summary, the subcommittee concludes that recent studies and analyses enhance the confidence in risk estimates that suggest chronic arsenic exposure is associated with an increased incidence of bladder and lung cancer at arsenic concentrations in drinking water that are below the current MCL of 50 ug/L. The results of this subcommittee's assessment ... suggest that the risks for bladder and lung cancer incidence are greater than the risk estimates on which EPA based its January 2001 pending rule." The subcommittee found that men and women who daily consume water containing 3 ug/L of arsenic have about a 1 in 1,000 increased risk of developing bladder or lung cancer during their lifetime. At 10 ug/L, the new drinking water standard adopted by USEPA, the risk is greater than 3 in 1,000. Additional information on the federal arsenic drinking water standard may be found on the internet at http://www.epa.gov/safewater/arsenic.html. The NRC report may be viewed on the internet at http://www.nap.edu/catalog/10194.html.

California legislation recently signed into law requires OEHHA to adopt a Public Health Goal for arsenic in drinking water by the end of 2002 and requires DHS to adopt a revised Primary MCL for arsenic no later than 30 June 2004. OEHHA is already in the process of preparing the draft PHG, which will consider the same epidemiologic studies cited in the NRC report. The high cancer potency from

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[1] The USEPA Integrated Risk Information System (IRIS) database contains a reference dose for non-cancer health effects from Cr VI, which is equivalent to 21 ug/L in drinking water.

these studies "yields a 1-in-a-million risk level in the low part per trillion range," according to Dr. Robert Howd, Chief of the Water Toxicology Unit of OEHHA. "Protection against all other effects (particularly stroke, heart disease, and hypertension), including an adequate margin of safety, requires a level in the low part per billion range. It should be noted that the arsenic level which would be protective against cancer is far below the limit of detection, which is about three parts per billion." The new PHG and the new drinking water standard adopted by USEPA will be factored into the development of the revised California drinking water standard by DHS.

Cancer Risk Level for Quinoline

In September, USEPA published new toxicologic criteria for the chemical quinoline in the Integrated Risk Information System (IRIS) database. The one-in-a-million incremental cancer risk level for quinoline in drinking water is 0.01 ug/L. Quinoline is a derivative of coal tar that is used in medicine and chemical manufacture. IRIS may be viewed on the internet at www.epa.gov/iris/.

Cancer Risk Level for Chloroform

In October, USEPA published new toxicologic information on chloroform in IRIS. Chloroform is one of the trihalomethanes formed when raw water containing organic matter is chlorinated to remove pathogens. USEPA has deleted the one-in-a-million incremental cancer risk level for chloroform from IRIS, based on new information regarding the mode of action for cancer from chloroform exposure. USEPA now considers the reference dose (RfD) for noncancer health effects from chloroform of 70 ug/L to be adequately protective of public health for cancer effects by the oral route because the mode of action for both cancer and noncancer health effects appears to be cytotoxicity — general toxicity to cells. This causes the dose-response relationship for cancer to have a threshold, below which cancer is not expected to occur. The RfD appears to be significantly below this cancer risk threshold.

New and Revised Drinking Water Action Levels

In August, DHS published a new toxicity-based Action Level for the solvent carbon disulfide of 160 ug/L. At the same time, the Action Level for vanadium was revised to 50 ug/L to account for data suggesting that a greater proportion of potential vanadium exposure for California residents comes from drinking water, as compared with other sources such as food. Action Levels are health-based advisory levels for chemicals that do not yet have primary Maximum Contaminant Levels (MCLs). More information on Action Levels may be found on DHS' web site at www.dhs.ca.gov/ps/ddwem/chemicals/AL/actionlevels.htm.

IRIS criteria, Action Levels and other toxicologic limits may be used to evaluate compliance with narrative water quality objectives for Toxicity in the Basin Plans, as these objectives relate to beneficial uses involving human exposures (e.g., municipal and domestic supply or "MUN"). Therefore, ambient groundwater or surface water with chemical concentrations above these criteria could be interpreted as violating water quality objectives if the waters are designated MUN.

Selecting Among Available Numerical Limits

The text *Selecting Water Quality Goals* at the beginning of the *Water Quality Goals* report provides information on how numerical limits may be used to implement narrative water quality objectives. However, it appears that many persons still have trouble selecting appropriate limits. The San Francisco Bay Regional Board has developed a manual of Risk Based Screening Levels for soil and water to guide

the assessment of contaminated sites. That manual uses default rules or algorithms for selecting among numerical limits. Such algorithms may also help users of the *Water Quality Goals* report. The following concepts should guide the derivation of such algorithms.

To be defensible, selected limits should be chosen so as to implement all applicable water quality objectives in the appropriate Basin Plan. For each constituent, the process involves three steps:

1) Select a single numerical limit to satisfy each water quality objective or portion thereof.
2) Select the lowest of the numerical limits from step (1).
3) Select the larger of
    a) the numerical limit chosen in step (2) and
    b) the natural background level of the constituent. [2]

These steps should provide a water quality numerical limit which if equaled or exceeded in ambient water, indicates that pollution has occurred. This is the least stringent limit below which ambient water would be in compliance with applicable water quality standards. It should be noted that antidegradation policies may require that more stringent limits be applied to ambient water quality, where the natural background level was not selected in step (3) above.

In step (1), with respect to toxicity information, there is a preference for:

- Purely risk-based limits over risk-management based limits, unless the water quality objective mandates the use of a risk-management based limit (e.g., the Chemical Constituent objectives mandates compliance with California Primary and Secondary MCLs);
- Limits developed and/or published by California agencies over those developed by federal agencies or other organizations (to be consistent with regulatory actions of our sister agencies);
- Limits that reflect peer reviewed science (avoid using draft or provisional limits, unless nothing else is available);
- Limits that reflect current science (e.g., IRIS numbers over USEPA health advisories).

Avoid using Proposition 65 limits. These limits are in conflict with other health-based limits in drinking water in California (i.e., PHGs and other health-based criteria from which MCLs are derived). The intent of Proposition 65 is to do two things:

- Provide warnings to persons prior to significant exposure to carcinogens and reproductive toxicants, and
- Prohibit significant discharges of these chemicals into sources of drinking water.

The intent of Proposition 65 is not to designate "safe" levels of these chemicals in drinking water. Other programs exist in California for that purpose, including the Public Health Goal program.

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[2] For the NPDES program and for other situations where it is not clear that background conditions represent true "natural background" (i.e., conditions have not been influenced by controllable water quality factors), the limit chosen in step (2) should be imposed even where background levels are less stringent. According to the SWRCB *Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California* (SIP), the water quality objective becomes the effluent limit in such cases. In SIP Section 1.4, Calculation of Effluent Limitations, Step 2 (page 6), when the water quality criterion (C), is less than the background concentration (B), then the effluent limit (ECA) is set at the criterion (C), not at the background concentration (B).

The general guidance above may be used to generate algorithms to help in selecting the most appropriate water quality numerical limits. Because some limits for groundwater and surface water differ significantly, separate algorithms are presented below.

An Algorithm for Groundwater

For chemicals in groundwater, the following water quality objectives and applicable numerical limits normally apply:

- Chemical Constituents Objective *(each of the following apply separately)*
  - California Primary and Secondary MCLs *(lowest of these)*
  - Numerical water quality objective from the Basin Plan
  - Concentrations that indicate impairment of any beneficial use
    - Agricultural use protective limits
- Toxicity Objective
  - Purely human health-risk based limits, *normally in the following hierarchy*
    - OEHHA Public Health Goal
    - Cal/EPA cancer potency factor at the one-in-a-million risk level
    - California State Action Level based on toxicity
    - USEPA IRIS criteria, *select the lowest of*
      - one-in-a-million cancer risk estimate
      - reference dose
    - USEPA Health Advisory, *select the lowest of*
      - one-in-a-million cancer risk estimate
      - lifetime non-cancer limit
    - USEPA MCL Goals *(non-zero values only)*
    - Other health-risk based limits *(check dates and basis before using these)*
      - National Academy of Sciences criteria
        - one-in-a-million cancer risk estimate
        - drinking water health advisory
      - Proposition 65 levels
- Tastes and Odors Objective
  - Taste- and odor-based limits, *normally in the following hierarchy*
    - California Secondary MCL
    - California State Action Level based on taste & odor

- Federal Secondary MCL
- USEPA National Ambient Water Quality Criterion based on taste & odor
  (do not use if limit is based on tainting of fish flesh)
- Other taste & odor thresholds from the peer reviewed literature

First, select one limit for each of the items above that begin with an arrow (➢). Second, take the lowest of those limits. The result should be a limit that applies all applicable water quality objectives. (Note: Natural background levels and antidegradation policies may modify this selection.) See also *A Note of Caution*, below.

An Algorithm for Inland and Estuarine Surface Waters

Different numerical limits apply to surface waters. Additional beneficial uses – for example, those that protect aquatic life – normally apply. There are additional constraints on surface water standards than on groundwater standards. The California Toxics Rule (CTR) and National Toxics Rule (NTR) contain promulgated and enforceable numerical limits for California inland and estuarine surface waters. CTR and NTR criteria preempt our interpretation of the narrative water quality objectives with respect to the toxicity of chemicals to humans and aquatic life. For example, if the CTR contains a human health protective criterion for the chemical of interest, it has precedence over the use of the Public Health Goal to interpret the narrative Toxicity objective with respect to human health protection. Likewise, if the CTR includes an aquatic life protective criterion, it supersedes any USEPA recommended aquatic life criteria for the same chemical, even if the latter are newer or more stringent numbers. The CTR/NTR constraint does not apply to groundwater. In addition, the CTR, NTR and USEPA Recommended Ambient Water Quality Criteria for human health protection should not be applied to groundwater, because they are derived assuming exposure through consumption of both water and fish/shellfish.

- ❖ California Toxics Rule and National Toxics Rule
  - ➢ Criteria for human health protection
    (use criteria for drinking water sources, consumption of water plus aquatic organisms, unless the MUN beneficial use has specifically been de-listed for the water body)
  - ➢ Criteria for aquatic life protection
    (use the criterion with the longest averaging period unless more frequent sampling justifies using criteria with shorter averaging periods)
- ❖ Chemical Constituents Objective *(each of the following apply separately)*
  - ➢ California Primary and Secondary MCLs *(lowest of these)*
  - ➢ Numerical water quality objective from the Basin Plan
    (may supercede CTR or NTR criteria if approved by USEPA)
  - ➢ Concentrations that indicate impairment of any designated beneficial use
    - Agricultural use protective limits

- Toxicity Objective
  - Purely human health-risk based limits, *normally in the following hierarchy (applies only if there are no CTR or NTR criteria for human health protection)*
    - OEHHA Public Health Goal
    - Cal/EPA cancer potency factor at the one-in-a-million risk level
    - California State Action Level based on toxicity
    - USEPA IRIS criteria, *select the lowest of*
      - one-in-a-million cancer risk estimate
      - reference dose
    - USEPA Health Advisory, *select the lowest of*
      - one-in-a-million cancer risk estimate
      - lifetime non-cancer limit
    - USEPA MCL Goals *(non-zero values only)*
    - Other health-risk based limits *(check dates and basis before using these)*
      - National Academy of Sciences criteria
        - one-in-a-million cancer risk estimate
        - drinking water health advisory
      - Proposition 65 levels
  - Aquatic life protective limits, normally in the following hierarchy *(applies only if there are no CTR or NTR criteria for aquatic life protection)*
    - California Department of Fish and Game criteria *(use the criterion with the longest averaging period unless more frequent sampling justifies using criteria with shorter averaging periods)*
    - USEPA Recommended Ambient Water Quality Criteria *(use the criterion with the longest averaging period unless more frequent sampling justifies using criteria with shorter averaging periods)*
- Tastes and Odors Objective
  - Taste- and odor-based limits, normally in the following hierarchy
    - California Secondary MCL
    - California State Action Level based on taste & odor
    - Federal Secondary MCL
    - USEPA National Ambient Water Quality Criterion based on taste & odor
    - other taste & odor thresholds from the peer reviewed literature

First, select one limit for each of the items above that begin with an arrow (➢). Second, take the lowest of those limits. The result should be a limit that applies all applicable water quality objectives. (Note: Natural background levels and antidegradation policies may modify this selection.)

A Note of Caution

Automatically selecting numerical limits by algorithm will not always generate the most appropriate limit. If specific beneficial uses do not apply, then limits protective of those uses should not be considered. It may make sense to deviate from the hierarchies listed above in specific cases. We may have information that certain numerical limits are outdated or are in dispute (see the discussion of PHGs for chromium, above). For example, boron has a DHS Action Level of 1000 ug/L and a reference dose from IRIS equal to 630 ug/L in drinking water. Normally, we would prefer using a California number over one from USEPA. However, the Action Level list from DHS cites the reference dose from IRIS as its source of the toxicologic information. Included is a note that DHS simply "rounded off" the value from 0.6 to 1 mg/L. This manner of rounding appears to defy logic. Perhaps a risk-management decision prevented the Action Level from being set at the toxicity -based level. In any case, the IRIS reference dose is more precise. So, for boron I would recommend using the IRIS reference dose instead of the DHS Action Level to implement the narrative Toxicity objective. What this example shows is that, while an algorithm may be a good place to begin the selection process, other information may need to be brought to bear on the final selection of water quality numerical limits.

Disclaimer

The recommended procedures discussed herein are not, nor intended to be Board policy, but rather an explanation of the staff practice of interpreting and applying standards and criteria for use in the Board's programs for water quality protection.

Updating Your Copy of *Water Quality Goals*

Please make the following changes to your copy of *A Compilation of Water Quality Goals*, August 2000 edition, to reflect the new information discussed above:

Inorganics Page 1

Carbon disulfide: Add entry of "160" for California State Action Level – Toxicity.

Nickel: Change the California Public Health Goal entry to read "12" and delete the footnote.

Chromium (III): Delete the California Public Health Goal entry.

Chromium (VI): Delete the California Public Health Goal entry.

Chromium (total): Delete the California Public Health Goal entry of 2.5, leaving the footnote "(134)".

Inorganics Page 2

Chromium (VI): Delete the entry for Cal/EPA Cancer Potency Factor and replace it with the footnote "(134)".

Inorganics Page 7

Uranium: Change the California Public Health Goal entry to read "0.5 ug/L = 0.43 pCi/L (162)".

Vanadium: Change the California State Action Levels – Toxicity to read "50".

Organics Page 14

Chloroform: Add entry of "70(108)" for IRIS Reference Dose. Delete the entry for One-in-a-Million Incremental Cancer Risk Estimates for Drinking Water - USEPA Integrated Risk Information System (IRIS) and change the footnote to read "(B2,108)."

Organics Page 73

Simazine: Change the California Public Health Goal entry to read "4" and delete the footnote.

Tetrachloroethylene (PCE): Change the California Public Health Goal entry to read "0.06" and delete the footnote.

Organics Page 74

Add a new line for Quinoline and an entry of "0.01" under One-in-a-Million Incremental Cancer Risk Estimates for Drinking Water - USEPA Integrated Risk Information System (IRIS).

Footnotes Page 2

(*108):* Change this footnote to read "The reference dose (RfD) for noncancer health effects is also considered adequately protective of public health for cancer by the oral route of exposure, on the basis of the nonlinear dose response for this chemical and the mode of action for both cancer and noncancer effects having a common link through cytotoxicity."

(*134):* Change this footnote to read "Withdrawn."

Add footnote (162) that reads "For natural uranium."

Please contact me by phone at (916) 255-3123 or CalNet 8-494-3123 or by e-mail at marshaj@rb5s.swrcb.ca.gov if you have questions or comments on the information presented herein.

cc: Frances McChesney, Catherine George, and Emma Suarez, Office of the Chief Counsel, SWRCB